Letters to the Editor

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Wavelength tuning of a superradiant DTDC iodide dye laser

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Polymethine dye lasers form an important class of dyes for the production of tunable laser sources by ruby laser pumping (Miyazoe 1970) 3, 3′-diethylthia-tricarbocyanine iodide (DTTC iodide) of this group of dyes has been found to lase with the 4% reflection of the glass surfaces of the cuvette walls when pumped by a giant pulse ruby laser either transversely (Schafer *et al* 1966) or longitudinally (Bass *et al* 1967) Superradiance also has been reported (Mack 1969).

We wish to report here the superradiant emission observed in 3, 3′-diethylthia-dicarbocyanine iodide (DTDC iodide) which is known to have stimulated emission band in the region 710-735 nm (Schafer 1970). The tuning of the emitted wave-length has been studied with the variation of concentration in ethylene glycol with the change of pathlength of the dye solution, and also with the solvent change for one concentration in a fixed path length.

One striking characteristic of many of these dyes is the very high gain which can easily be obtained The gain may be so high that laser emission is obtained in a dye cell in the absence of mirrors, indicating the build up of a pulse in a single passage through the dye cell pumped by a ruby laser. On the other hand the output from a superradiant system may be described roughly as incoherent laser emission In some instances where the full temporal and spatial coherence of a laser is not required a superradiant source can be a useful device as well as a simple one, since no mirror configurations are required.

The unfocussed output of a Q-switched ruby laser of 15 MW with a pulse duration in the neighbourhood of 15 nsec was incident on the plane surface of standard absorption glass cell containing the ethylene glycol solution of the dye The dye laser output emerging from the opposite side of the cell was focussed on the entrance slit of a glass prism spectrograph. Superradient emission was recorded for cell lengths of 5, 10, 20 and 45 mm for concentrations in the range 10^{-4} to 2×10^{-3} M

Figure 1 is a plot of the superradiant emission wavelength versus concentration of the dye in ethylene glycol for two cells The wavelengths plotted correspond to the centre of the emission band. Figure 2 shows the superradiant emission spectrum of the dye in ethylene glycol in a 10 mm standard absorption

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cell with the concentration varying from 1.5×10^{-3} M to 1.25×10^{-4} M in steps from top to bottom. Table 1 lists the centres of the emission bands observed in 10 mm cell, with 8×10^{-4} M solutions of the dye in other solvents. We are presently investigating the physical processes involved in this solvent tuning.

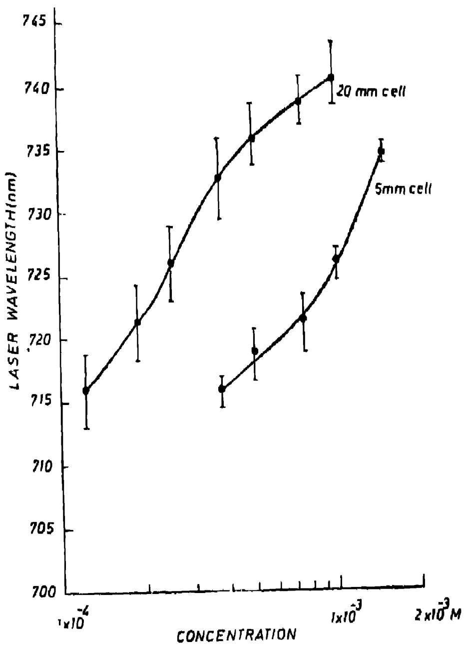

Fig. 1 Superradiant dye laser wavelength vs dye concentration.

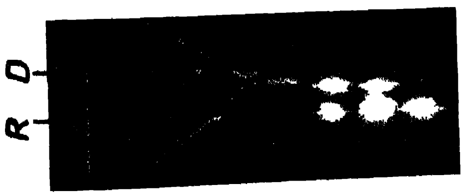

Fig. 2. Superradiant emission of the dye in ethylene glycol in a 10 mm standard absorption cell (Concentration 1.5×10^{-3}M to 1.25×10^{-4}M in steps from top to bottom).
R : Ruby line, D : Dye emission.

Table 1. Centros of superradiant emission wavelength in different solvents

Solvent	in *nm*
Ethylene glycol	734
Propylene glycol	722
Glycerol	713
Diethylene glycol	719
Dimethyl sulfoxide	740

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Crystal dynamics of gold

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The phonon dispersion curves for gold have been computed assuming central (Delaunay 1953, Clark *et al* 1964) and angular (Sharma & Joshi 1963) volume interactions. The curves shows fairly good agreement with the experimental ones reported by Lynn *et al* (1973)

Lattice dynamical behaviour of gold (fcc) has been discussed on the basis of following three types of simpler interactions

(a) Central interaction depending upon the mutual distance between the ions

(b) Angular interaction depending upon the angle between the line joining the displaced ions with the equilibrium position of the line. Delaunay (1953) as well as Clark *et al* (1964) angular interactions have been considered.